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A ROTARY FLIGHT TRAP USED FOR SAMPLING *HAPLAXIUS CRUDUS* (HOMOPTERA: CIXIIDAE) IN COCONUT GROVES[1,2]

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Abstract.—Woodiel, Neil L., and Tsai, James H., Postdoctoral Research Associate and Asst. Professor of Entomology, respectively, Agric. Res. Ctr., University of Florida, 3205 SW 70th Ave., Fort Lauderdale, Florida 33315. Present address of senior author: Arrowhead Drive, Box 422, McMinnville, Tenn. 37110.—A rotary flight trap was successfully devised to sample flying insects associated with the palm community in south Florida. This machine consisted of a triangular support unit, and a boom and net assembly powered by an electric motor. Traps were operated three weeks per month for 12 months during 1974–1975. Although over 50 species of insects were periodically collected, *Haplaxius crudus* (Van Duzee) was trapped throughout the year. The flight activities of this insect appeared to be high in March, May, September and November. While in operation, the nets sampled 4,741 cu m of air per hour for insects. A list of materials necessary to construct this sampling unit is presented.

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Introduction

Bonnet (1911) conceived the idea of a constantly moving aerial net to sample airborne insects in France by attaching a net to his car. Later Byers (1928) collected dragonflies and McClure (1938) collected general insect populations by this method. Similar aerial nets were used in the leafhopper and mosquito studies by Chamberlin and Lawson (1940, 1945) and Stage and Chamberlin (1945). Airplanes were used to sample the wind dispersion of gypsy moth by Collins and Baker (1934). Davies (1935) used water power as energy for his nets, and Williams and Milne (1935) used electricity as the power source for their nets. Small gasoline engines were adapted for use by Barnes et al. (1939) and Chamberlin and Lawson (1940, 1945). The rotary nets employed in this study were a combination of previously used systems best suited for the studies conducted.

This study was conducted to test the utility of the aerial net for determining which insects most commonly fly in and around coconut palms in southeast Florida in hopes of determining which of these insects might be vectors of the lethal yellowing (LY) disease agent of coconut palms. Because *Haplaxius crudus* (Van Duzee) was reported by Schuiling and

Johnson (1973) to be abundant in coconut plantings in Jamaica, special emphasis was given to this insect and observations on trapping this planthopper are reported here.

Materials and Methods

This machine consists of three sections: (1) the support system; (2) the power unit; and (3) the boom and net assembly (Fig. 1). The total number and type of items required to construct each section are listed in Table 1.

The machines were mounted at three heights (1.5, 4 and 8 m) around the groves of coconut palms. Traps were operated Monday through Friday, three weeks per month, over a 12-month period.

With a net opening of 35.6 cm diameter and a boom length of 3.65 m, the two nets sampled a volume of 4,741 cu m of air per hour for insects, or approximately 114,000 cu m of air in 24 h, when spinning at 30 revolutions per minute. At the end of each collecting period, the small collecting bags attached to the rear openings of the trap were removed and emptied into a killing jar.

Sample areas were located in Broward and Dade counties, Florida. In Dade County, the Doral Country Club was chosen for sampling since it had a very high incidence of LY. In Broward County, the Agricultural Research Center (ARC) in Fort Lauderdale was chosen since the disease was not present in the immediate vicinity at the start of this study. At each site the nets were placed near and under coconut palms.

Results and Discussions

The rotary flight trap is an excellent quantitative sampling method for flying insects and can be varied to fit many situations. Since it is nonselective, it offers a means of determining the population density of any flying insects at different elevations and at different times of the year. The traps were occasionally blown over by the wind but this was later prevented by securely anchoring them in the ground. When blowdowns occurred some type of safeguard was required to stop the machine from rolling due to the power of the motor. A pin of soft metal was inserted through the motor shaft and base of the boom assembly which would shear if the machine were to tip over. This avoided stress to the gears of the reduction assembly. The motor shaft was threaded so the base of the boom assembly could be screwed onto it. When the pin which held the two together was sheared, the boom would unscrew and fall to the ground rather than continue to tighten. This also reduced the stress on the power assembly.

Speed of operation definitely affected the efficiency of the machine. The ¼ hp motor produced 4.5×10^8 Dyne-cm of torque at the shaft, more

Table 1. Materials required to construct a rotary net with the materials listed by units.

Units	Total materials required
Support unit	
Angle Aluminum (3.81 cm angle for frame)	7 m
Sheet Aluminum (38 mm sheet for top)	52 sq cm
Sheet Aluminum (8 mm sheet for sides)	3 sq m
Plywood (2.5 cm for motor support)	116 sq cm
Plywood (2.5 cm for bearing support)	65 sq cm
Power unit	
Ceared electric motor (¼ hp) (Dayton® Model 5K939)	1
Universal Joint Assm. (19 mm)	1
Shaft (19 mm in cold rolled steel)	60 cm
Steel Sheet (13 mm thick, 49.5 × 22.7 cm wide)	1,045 sq cm
Self-aligning Bearings (19 mm)	2
Electrical Cord	3 m
Electric Plug (Male)	1
Bolts 6.3 × 76 mm (for shaft pin)	1
Bolts 6.3 × 32 mm (motor support)	12
Boom assembly	
Rigid conduit, 13 mm	6 m
Cross coupling, 13 mm	2
Short nipple (13 mm)	1
Cable 3 mm (plastic coated)	12 m
Eye bolts 13 mm	9
Turnbuckle 13 mm	3
U-clamp 13 mm	6
L-coupling 13 mm	2
Cotterpin (heavy duty)	4
Nets	
Steel rod 6.3 mm (for hoops)	18 m
Aluminum 13 × 3 mm	3 m
Reinforcing rod 2.5 cm	5 m
Net materials	2 sq cm
Saran 52 mesh	452 sq cm

The total cost for the above materials is estimated to be $60.00.
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of power than required to do the desired work. The rpm could be increased from 30 to 60 with the same motor and the torque reduced to 2.3×10^8 Dyne-cm. This would still be sufficient to operate a 3.66 m boom and at a more effieient rate. Higher rpm prevents insects from dodging the moving nets and from flying out of the nets after being caught.

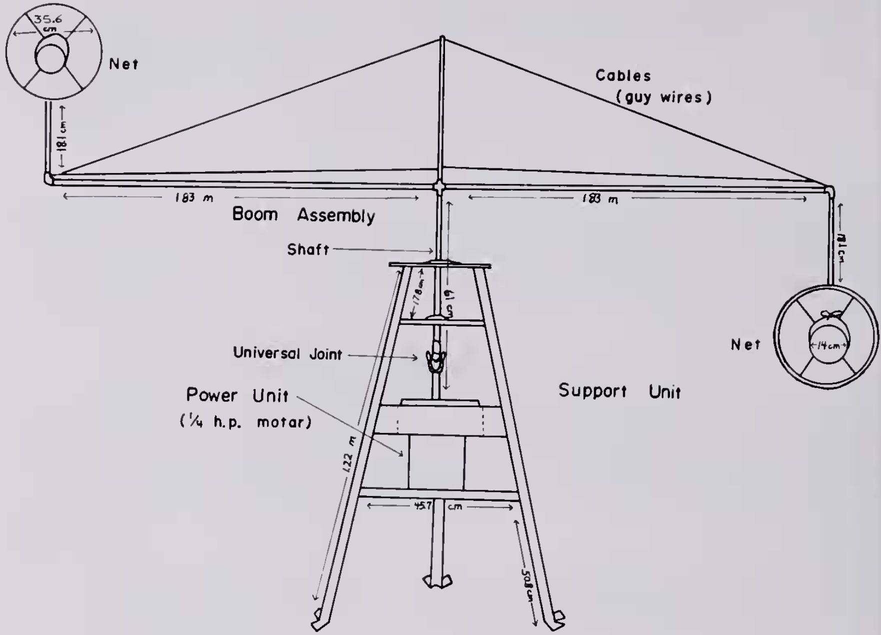

Fig. 1. Diagram of rotary flight trap and the specifications of assembly.

The electric motor requires less attention and appears to be more reliable than other power sources.

One feature of the system which can be adjusted is the length of the boom. The boom in our study was 3.66 m in length as it had been in earlier studies (Chamberlin and Lawson, 1945; Barnes et al., 1939); however, a 3.05 m length boom was used by McClure (1938). Diameter of nets in our study was 35.6 cm while those used in previous studies had varied from 48 cm (Chamberlin and Lawson, 1945; Barnes et al., 1939), to 25.4 cm (McClure, 1938). Various sizes of the nets and booms used in previously mentioned studies give some indication of the flexibility of this system.

The nets can be modifed to operate at any angle from the vertical to the horizontal. The machine used in this coconut study was operated with the boom spinning on a horizontal plane with one net suspended below the boom and one placed above the boom (Fig. 1).

In our studies with the aerial net, over 50 species of insects were collected. Nearly 90% of the total leafhoppers and planthoppers trapped in the nets at each sampling site was *H. crudus*. This confirmed the observations made in Jamaica by Schuiling and Johnson (1973). Therefore, this insect was considered as a prime suspect as a vector of LY (Tsai, 1975, 1977).

Populations of *H. crudus* vary not only from area to area but also at

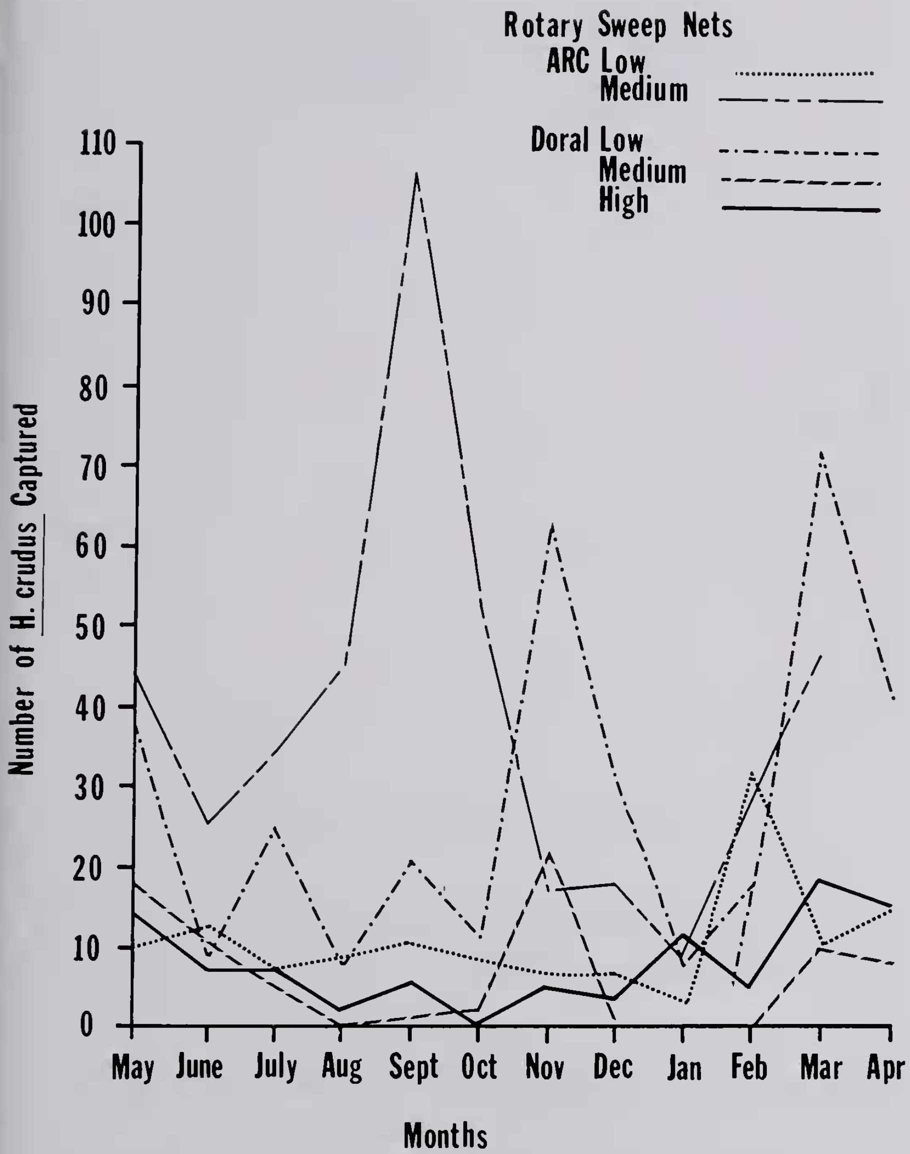

Fig. 2. Monthly average numbers of *H. crudus* captured in the rotary flight traps at the Agricultural Research Center and Doral Country Club (Low = 1.5 m; Medium = 4 m; High = 8 m).

different heights above the ground (Fig. 2 and 3). The nets which collected the highest number of *H. crudus* were the 4 m nets at the ARC. They were located near several mature coconut palms and a large coconut seed bed. The 1.5 m nets at the ARC were located under the same trees

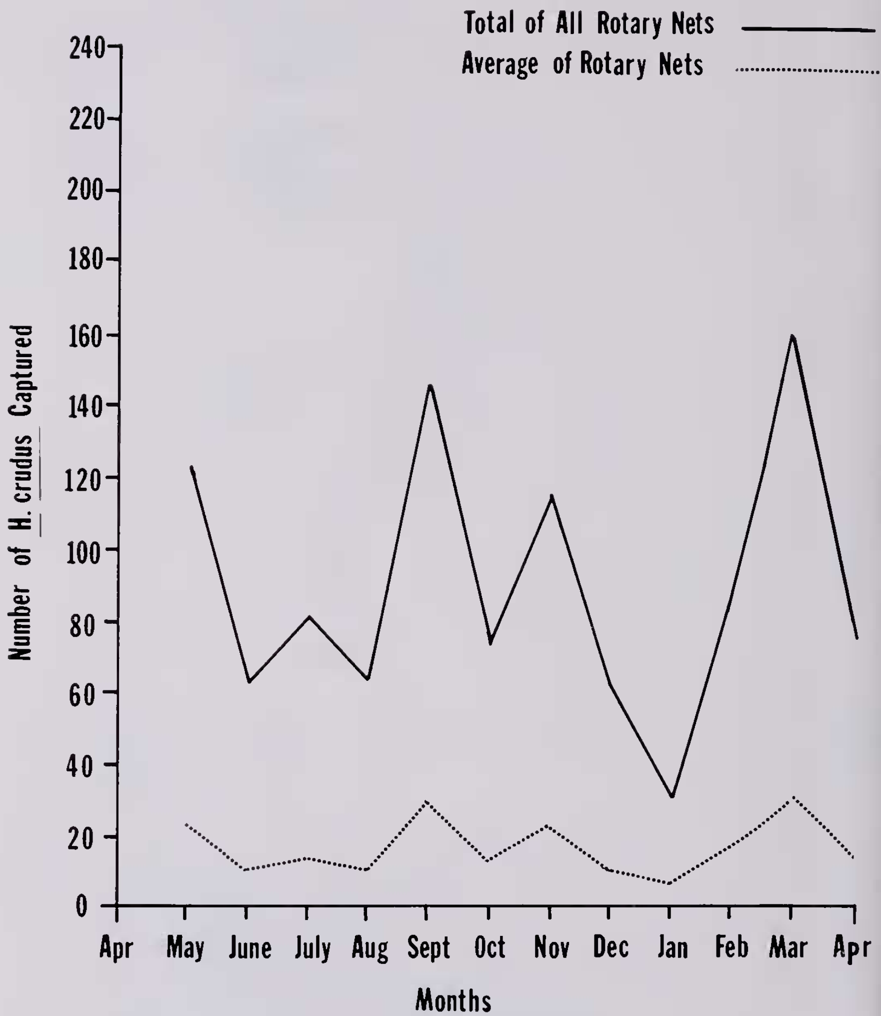

Fig. 3. Monthly total and average numbers of *H. crudus* captured in all rotary nets from the Agricultural Research Center and Doral Country Club.

almost within the seed bed, caught considerably fewer insects than the 4 m nets. In contrast, the traps at Doral captured considerably more *H. crudus* in the 1.5 m than the 4 m or 8 m nets, because more St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze), bermudagrass (*Cynodon dactylon* (L.) Pers.), and bahiagrass (*Paspalum notatum* Flugge) were planted on the Doral golf course than on the site of ARC. It is conceivable that more *H. crudus* migrated from their breeding hosts to their feeding hosts. All nets at Doral were located in close proximity to mature palm trees which were healthy when the study began. By the end of the study, one year later, 90% of coconut palms had succumbed to LY and were removed from the Doral study area. Samples in the nets did not differ before or after removal of the palms. This indicated that *H. crudus* may feed on other plants still on the golf course and is not really affected by the loss of the palms. This would indicate also that plants other than coconut palms could serve as alternate hosts of *H. crudus* and possibly the LY causal agent. The current research efforts are directed at the search for alternate hosts. The average numbers of *H. crudus* did not fluctuate greatly during the entire year. The maximum difference in monthly average was seven fold. In the rain months (mid May to late September), the average numbers of *H. crudus* samples were relatively less. The flight activities of this insect appeared to be high in March, May, September and November (Figs. 2 and 3). Since this insect was found throughout the year it could help explain why the infection rate of LY remains constant throughout the year (McCoy, 1976). This study of flight patterns of *H. crudus*, therefore, becomes an important aspect of LY research in view of experimentation as well as control.

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Footnotes

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[2] Florida Agricultural Experiment Station Journal Series No. 721.